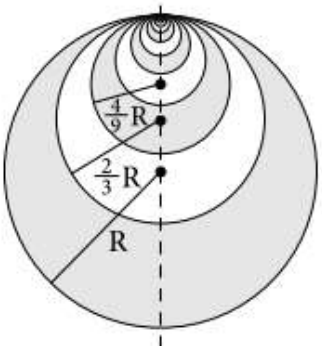
METÓDY RIEŠENIA FYZIKÁLNYCH ÚLOH zima20 – Príklady 3

Cvičenie 29.10.2020

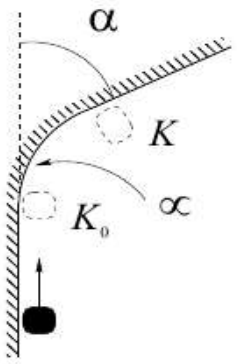
Príklad

Samko si v obchode kúpil veľkú cibuľu. Zabudol ju však na balkóne a časť vnútra mu zoschla. Cibuľa teraz vyzerá ako guľa s polomerom R, v ktorej je prázdna guľa s polomerom $\frac{2}{3}R$. V tejto dutine je opäť plná guľa s polomerom $\left(\frac{2}{3}\right)^2 R$, v ktorej je dutina s polomerom $\left(\frac{2}{3}\right)^3 R$. V tejto dutine je opäť plná guľa, a tak ďalej… Aký je moment zotrvačnosti zhnitej cibule okolo osi symetrie zobrazenej na obrázku, ak jej hmotnosť je M?



Príklad 2

An object is sliding on floor along a wall. The floor is frictionless, but there is friction between the object and the wall, and the friction coefficient is μ. The wall makes a smooth turn, by angle α. Just before the turn, kinetic energy of the object is K_0. Find the kinetic energy right after the turn is completed.



Príklad 3

35. Polpriamka je nabitá nábojom λ na jednotku dĺžky. Nájdite veľkosť a smer intenzity elektrického poľa v kolmej vzdialenosti d od konca priamky.

Príklad 4

A Newtonian test particle orbits in a central potential $V(r)$, i.e. the acceleration of the particle is $-\vec{\nabla}V$.

a) Determine the period of a circular orbit of radius r, in terms of $V(r)$ and its derivatives.

b) Suppose that the orbit is slightly noncircular, with $r(t) = r_0 + \epsilon(t)$ where r_0 is constant. Find the **general solution** for $\epsilon(t)$ in the limit $\epsilon^2 \ll r_0^2$; your answer should depend on the energy per unit mass E and on $V(r_0)$ and its derivatives. Determine the period of radial oscillation in terms of $V(r_0)$ and its derivatives.

c) Show that there are no stable circular orbits for the Yukawa potential

$$V(r) = -\frac{GM}{r}e^{-kr} \ , \tag{1}$$

if $r > (2k)^{-1}(1 + \sqrt{5})$.

d) Show that it is possible to have bound orbits with positive energy for the Yukawa potential (with $V = 0$ at infinity).